Title	Theoretical investigations on the attenuation of electromagnetic wave due to rain
Sub Title	
Author	小口, 知宏(Oguchi, Tomohiro)
Publisher	慶応義塾大学藤原記念工学部
Publication year	1965
Jtitle	Proceedings of the Fujihara Memorial Faculty of Engineering Keio University (慶応義塾大学藤原記念工学部研究報告). Vol.18, No.71 (1965.) ,p.74(10)- 74(10)
JaLC DOI	
Abstract	
Notes	Summaries of Doctor and Master Theses Doctor of Engineering, 1965
Genre	Departmental Bulletin Paper
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=KO50001004-00180071-0010

Theoretical Investigations on the Attenuation of Electromagnetic Wave due to Rain

Tomohiro OGUCHI*

The results of the propagation tests in 8.6 mm wave-lengths show that the attenuation of electromagnetic waves due to rain is not the same for vertically and horizontally polarized waves. The aim of the first half of this paper is to clarify this phenomenon in the theoretical point of view. The photographs of raindrops show that the bottom of falling drops are always flattened. Consequently, it is expected that the scattering and absorbing effect of electromagnetic waves due to rain is no longer the same for vertically and horizontally polarized waves.

Theoretically these deformed drops can be assumed to be of oblate spheroids. Introducing the expression of the total cross-section, (sum of the absorption cross-section and the scattering cross-section), of a spheroidal particle with small eccentricity, the theoretical relation between attenuation and the rate of precipitation for vertically and horizontally polarized plane waves is obtained. The numerical computations are performed at 12 frequencies from 4 Gc/s to 100 Gc/s. The results of computation show that the smaller attenuation is expected in case of vertical polarization and the difference between the attenuation in horizontal polarization and that in vertical polarization divided by the attenuation in vertical polarization, under the condition of constant rainfall rate, becomes very small as frequency becomes higher except a frequency range from 30 Gc/s to 60 Gc/s. The coincidence of the observed value with the theoretical value may be thought to be fairly well.

In the transmission of wide-band signals through the rain in the millimeter wave region, the fluctuation of received signals might be a serious problem. So, the latter half of this paper deals with this problem theoretically in case of single frequency transmission. The effect produced by the raindrops falling in the propagation path appears at the receiving point just like what would appear in the output circuit by a stream of electrons flowing from the cathode to the anode in vacuum tubes. This phenomenon in vacuum tubes is well known as the shot effect. So, we can apply the theory of the shot effect to the present case. The result of computation shows that the fluctuation of received electric field obeys approximately the two-dimensional normal distribution law if we consider the real and imaginary parts of the received electric field as the components of two-dimensional vectors. The results of numerical computations in 8.6 mm wave-lengths show a very small fluctuation occurring under the normal conditions.

*小 口 知 宏